

Web-Based Mapping Tools Help Governments Transform GIS into New Services

Contributed by Dennis Goreham
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Vander Veen

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Not so long ago, only a select group of users could take advantage of GIS tools and applications. The general public barely knew what GIS was, let alone knew how to use it. Today, the Web allows GIS data to be distributed via ever-evolving avenues, from the practical - traditional GIS services made available online - to imaginative applications like Google Sky, a Web-based, 3-D map of the universe.

Citizens, businesses and governments are finding new ways to reap the benefits of this revolution in how location data is understood and depicted. Data once found exclusively in GIS circles is appearing in common, everyday tools.

Some people wonder if these emerging applications should be considered GIS at all. Has the combination of location data and the Internet created something altogether new? How can government use new mapping tools to not only enhance citizen service, but also improve internal efficiency? And how do traditional GIS applications match up against the new kids on the block? These are just a few of the questions that have arisen in what may well be the golden age of GIS.

More Than a Map

For years, GIS existed as a tool for only technically skilled users. This was largely because most people couldn't tell what the heck these maps were supposed to depict. Companies such as ESRI and CARIS produced powerful mapping software that has been used for everything from wildlife management to sales and marketing; generally these products appealed only to a small community of experts.

Furthermore, GIS software was stand-alone and ran on large, high-end systems that could process the thousands of data points and layers needed to produce, say, a map of a suburban housing tract being developed in a floodplain. It was incredibly useful for a select number of people - but nevertheless, GIS wasn't much more than a complicated-looking map on a computer.

For millions of people today, the Web is as vital a utility as electricity or water. As technology is wont to do, GIS has not only adapted to the changing marketplace; it has also expanded beyond its traditional realm. GIS applications have transformed into simpler, user-friendly tools with mass appeal and - most important - they live entirely on the Web. Today, location data powers all kinds of programs, including many in government.

"Over the last several years, we've seen a move toward Web enabling many of our traditional GIS technologies, which has taken us into some really different opportunities to apply applications, which I think has dramatically changed the landscape for us," explained John Olesak, vice president of Northrop Grumman's Geospatial Intelligence Operating Unit. Olesak has more than 30 years of GIS experience under his belt, including work with the National Geospatial-Intelligence Agency.

"So if you think back a number of years ago to the geographic information systems being almost a boutique-type of capability, you really had to be a computer scientist, photogrametrist or geodesist to really take advantage of it," he said.

"Now we can deliver those applications into the hands of many more users at a variety of different levels. All with the simplicity of the tool to help us in decision-making, whether that's personal or from a business or homeland security perspective."

You could throw a dart at the map of the United States and probably hit a city or state that's doing something clever with location data. Whether it's "true GIS" or some sort of new hybrid depends on the individual application and whether you care about the distinction. In Utah, for example, traditional GIS tools exist side-by-side with Google Earth. The state built mapping tools that do everything from helping anglers find the best fishing to pinpointing all of the state's mining sites.

Utah's state Web site is home to a huge library of maps created with both traditional GIS applications and tools from Google. In fact, Utah Deputy CIO Dave Fletcher said the state keeps all of its geographic information databases online, giving Utah citizens an impressive resource at their fingertips. One new Web site, mapserv.utah.gov, hosts interactive

maps on the ArcGIS server.

"We're also starting to create Web services that can be used within other peoples' applications to provide geo-coded results," Fletcher said. "We've created some things, our geo-sites using Google Earth, where it's sort of targeted at the student population, where they can basically do virtual flyovers over a lot of our geologic sites throughout the state."

Utah's Mapserv site is a great place to start for anyone seeking examples of how traditional GIS tools and newer "GIS-lite" applications can be used to produce compelling, useful maps. Mapserv hosts a variety of maps, including sex offender addresses, sites designated for historic preservation - even fueling locations for government fleet vehicles.

According to Fletcher, the state is doing everything it can to improve the public's access to GIS and other related data because the state believes the data improves people's experience with government and also strengthens government operations. Furthermore, Fletcher said new manifestations of location data - such as Google Earth and WikiMapia - don't diminish the traditional GIS market, but instead foster more interest in it.

"I think it significantly expands interest in [GIS], and I think some of the other products are trying now to compete and enhance what they do - where before they were generally client-server applications," Fletcher said. "They've seen what people have been able to do with Google Earth and are providing new functionality, which people are taking advantage of."

"Some of our GIS purists don't necessarily like it, but that's the way of the future. People want to have access to those kind of tools whereas, before, it was more exclusive."

Dixie Developments

Utah isn't the only state making the most of Google Earth. In late November 2007, Alabama Gov. Bob Riley announced the launch of Virtual Alabama, a project initiated by the Alabama Department of Homeland Security in partnership with Google Earth. The first-of-its-kind project, which was two years in the making, incorporates imagery from all of Alabama's 67 counties, and allows local officials to securely share access to statewide geographic data using Google Earth.

Virtual Alabama means mission-critical GIS data is no longer accessible only by GIS experts. Instead, GIS data can be quickly and easily obtained by first responders, helping them do everything from planning an escape from a burning building to evacuating areas affected by a hazardous chemical spill.

According to state Homeland Security Director Jim Walker, people issues - not technology challenges - were the biggest hurdles to creating Virtual Alabama. The state had to find up-to-date imagery of each Alabama county, a process that took more than a year to accomplish, Walker said. Along the way, political infighting and proprietary issues bogged down the process. The key, Walker said, was explaining how Virtual Alabama would improve public safety and help protect the lives of first responders.

"I went to the sheriffs and said, 'Look, if you give me this imagery, we've learned that we can start layering and tailoring information on top of your imagery that can allow you to do a lot of things. For example, we can show gas lines, power lines, fire hydrants, stop signs, stop lights, the location of every registered sex offender in your county. If you click on a button, this is where a sex offender lives. [If] you draw a 1,000-foot circle around his house, and pull up all the schools, bus stops, day-care centers, etc., you know immediately if he is violating his parole.'

"We can 3-D model buildings and say, 'OK, you want to take down a meth lab or you want to have a surveillance or SWAT operation? Before you even go, you can do rehearsals, view line of sight, determine a way in, a way out, the best ways to enter, before you ever put an officer in harm's way. You can save lives.' Boy, they jumped all over that."

Virtual Alabama is unique for several reasons. First, the program succeeded where others failed by defeating the jurisdictional and proprietary issues that dog other projects. Walker credits Riley for delivering the necessary executive leadership and Norvin Goddard, a rocket scientist on loan to the state from the U.S. Space and Rocket Center in Huntsville, Ala., for creating an application that uses the power of GIS data and delivers it in a format that even nontechnical emergency personnel can use during a crisis. Walker, a former soldier and firefighter, also believes that the platform Google Earth provides was paramount in making Virtual Alabama a reality.

"We have all 67 counties loaded; it's the most comprehensive data set in the country," Walker said. "No other state has it. What's beautiful about this program is it reflects the best of government."

Virtual Alabama gives emergency personnel - county commissioners, sheriffs, police chiefs, firefighters and emergency managers - the ability to achieve things they wouldn't otherwise be able to do. For example, with the 3-D modeling capabilities built in to Google Earth, law enforcement agencies can visually render a suspected drug lab, allowing SWAT officers to determine lines of sight, and the best entry and exit points. Similarly firefighters racing to a burning structure

can quickly determine the fastest route to the site and whether any hazardous materials may be stored there.

Virtual Alabama also provides tools that help emergency officials react to even the most uncommon scenarios, such as a toxic gas cloud that may threaten a population.

"You can do plume modeling on the fly," Walker explained. "Let's say a tanker truck overturns on the interstate and is spilling chlorine gas. We populate all these real-time data centers on Virtual Alabama. I can click a couple of buttons and see what the temperature is - the wind direction, wind speed, etc.

"You factor all this stuff into a little software program called Aloha that's embedded in Virtual Alabama, and it will give you a plume model and tell you - given the fact this is chlorine gas - it's going to go in this direction, these are the people most likely to die, these are going to be incapacitated."

The hardware, software and licensing fees required to build Virtual Alabama set the state back \$150,000. Even at such a bargain price, Walker claims Virtual Alabama is the most complete data set in the country. He doesn't appear to be exaggerating.

In addition to the capabilities already described, Virtual Alabama also features the floor plans for all Alabama schools and can layer data describing the concentration of students on campus at any given time. If a school shooting, or the threat of one, is reported, responders can quickly determine how and where the student population is distributed on campus. And if a school has surveillance cameras, the video can be viewed in real time.

What's more, Walker said Virtual Alabama helps cross the digital divide that exists between wealthy counties and their more rural neighbors.

"We've got some pretty poor rural counties in Alabama. It levels the technological playing field. If you've got a computer, you can layer and tailor just like the wealthier parts of the state," Walker said "We're empowering people who've never been empowered before."

Viva Sheboygan

The evolution of GIS is making an impact around the world, though in many cases, you don't have to go anywhere to experience it. Las Vegas and Sheboygan, Wis., are each enhancing the business of government through the use of clever GIS applications.

In Las Vegas, e-government managers Greg Duncan and Anthony Willis are rolling out an array of citizen-facing services that seamlessly employ GIS technology without end-users ever noticing it. Their motivation to deliver tools that use location data stems from a realization that using GIS no longer means you need to have a wealth of expertise.

"Instead it can be something where you can answer spatially related questions through a Web browser," Duncan said. "And that's what we've been trying to do with some of the new services we're starting to launch on the city's Web site. The user of the system doesn't have to be a GIS analyst, but [he or she] can still answer spatial questions."

In Sin City, it's the visitors who are usually the ones at the casinos. Residents of Las Vegas are just like anyone else. And as Las Vegas grows, people who live there may want to learn more about what their city offers. For example, arranging a special event at a city park used to mean finding the phone number for the parks and recreation department. Now, that service is available online at any time, with the data only a few mouse clicks away.

On the city's site, a user need only look on the left side of the screen and find the "I Want To ..." menu. The menu boasts an array of different services that can be accessed easily. One of the choices is "find." Selecting it brings up more options, such as "missing pets," "emergency services" and "parks and facilities." By choosing parks and facilities, a user can search parks by features or address. Currently there are 31 features a user can select to narrow a search - everything from baseball fields to bocce ball to fishing ponds. Once options are selected, the matching parks are displayed, each with a link to Google Maps. All this can be done in a few seconds.

The city also offers an online 311-type service that lets residents and visitors report problems or nonemergency incidents. While this might not seem particularly innovative on the surface, what many people don't realize is that a large portion of the famed Las Vegas Strip isn't actually in the city of Las Vegas, but in an unincorporated part of Clark County. With the system the city has built, someone who finds graffiti outside Caesars Palace or suffers a dog bite near The Venetian can simply input the approximate location, and the system will direct the person to the appropriate agency.

"Say someone rolls into a pothole outside the Bellagio in the middle of Las Vegas Blvd.," said Willis. "Many tourists would likely say, 'Hey, city of Las Vegas, you're responsible for this.' But actually it's Clark County. Now, the new way, you just tell what type of problem it is and where it exists, and this utility will link you to the right spot. No map involved, but it's

fully GIS as the backbone of this application."

In Sheboygan, Wis., city officials are taking advantage of next-generation GIS to enhance internal operations by providing emergency responders a better look at what they're dealing with. The city wanted a way to give public safety the upper hand when disaster strikes. Tom Horness, the city's GIS specialist, found that software from Autodesk, a company specializing in CAD and 3-D imagery, offered tantalizing possibilities.

Sheboygan officials discovered that by using Autodesk tools, they could render their entire downtown in lifelike 3-D. Even more impressive: The software lets city personnel see inside of buildings and under streets.

"For the city of Sheboygan, they realized they needed to be able to create a fully integrated environment that would enable their first responders, who are inherently nontechnical, to navigate the inside and outside of all the buildings within their city," said Juliana Slye, Autodesk director of government. "To be honest with you, a firefighter is not going to open up a GIS application. They'll start pointing and clicking. They need something that is just really one or two snaps away from giving them all the information."

First, Sheboygan's GIS manager set up a small "pilot project area" by designing just a few buildings and inputting basic footprint data.

"Then they married that footprint data, which is much more of an engineering data, to things like digital personal mapping data and aerial photography," Slye said. "They began to build this really smart digital environment that allowed them to really provide all this precision information in a Web-based interface that any firefighter could quickly navigate."

The Autodesk software takes CAD drawings, blueprints, schematics and GIS data, blends it together and spits out a highly detailed, 3-D rendered environment. For this article, Autodesk provided a virtual tour of what its software is doing for military officials in Iraq. The tour centered on a street in Baghdad, complete with moving cars, pedestrians and structures. One particular building afforded both exterior and interior views. From inside the structure, you can look out the windows and determine where, for example, possible sniper shots might enter.

The software also allows officials to strip away all the structures if they wish, exposing the sewer and electrical infrastructure. In fact, nearly anything designed in CAD and placed on a map can be generated virtually. Autodesk and others are creating virtual worlds that are practical and incorporate real-world data that can be layered just like traditional GIS. Only now, the end result is more than the sum of its parts. Most of the data rendered in these virtual structures - the plumbing, the walls, the number of steel girders, the thickness of the drywall in the building - already exists in digital format in the state offices. It's up to agency officials to make the decision to take advantage of it.

"We call it 'democratizing' the design data, breaking it out of the engineering department, and putting it in the hands of the business leader," Slye said. "One of the things we've seen is a really strong synergy now between the nontechnical decision-makers inside of government agencies and the engineering department getting closer together, and closer alignment between what's being created and what's really needed."

Google Earth, Autodesk and a host of other platforms offer possibilities limited only by the imagination. But do these applications threaten the demise of traditional GIS?

Old-School Renewed?

It might seem like these new, user-friendly manifestations of GIS data would spell the end for ESRI, CARIS and other traditional GIS solutions providers. But according to those using new-school applications, the opposite is true.

At deCarta, a company specializing in providing geospatial data and imagery to Google, Ask, Rand McNally, Zillow and others, Business Development Vice President Mike Agron said the new GIS opens the door for traditional GIS applications by creating new opportunities to use the data they create.

"The promise of GIS is huge - the promise of location-based information, the promise of location intelligence," Agron said. "I think the broader implications are that location is only going to become more and more important in our decision-making process. It's only going to become more pervasive in everything we do. The likes of the Web, and the power of the Web, are going to make that show."

Web-based GIS platforms signal a revolution in how government uses GIS data to improve citizen services and strengthen internal operations. And a role for traditional, more powerful GIS systems is likely to materialize as it has in Las Vegas, where ESRI tools like ArcGIS do the back-end work, and Google Earth delivers the data in a user-friendly format.

Chikai Ohazama, product manager for Google Earth, said the relationship between old and new need not be adversarial.

He said both can coexist and prosper if each is put to proper use.

"ArcGIS is really good at doing analysis of geographical data," he said. "You're trying to do watershed-sort of calculations or all different kinds of models to analyze the data you have. Google Earth, its forte, is more like taking the information that's used, already analyzed, and presenting that to the public so anybody can look at it and see how it impacts them, or see what it means."

Ohazama refers to Google Earth as "GIS for the masses." It's an apt description, given how many people now can utilize location data for a thousand different purposes. All industries and technologies evolve, and the stalwarts eventually are usurped by the upstarts.

But the GIS industry may be different. Now, more than at any time in history, people have incredibly powerful and relevant ways to interact with the world they live in. Whether that world is real, or only a virtual representation, GIS has grown to be far more than a mere electronic map.

Perhaps most important is the fact that - as Chuck Herring, communications director at satellite imagery provider Digital Globe, said - this new generation of GIS is doing what every technology should eventually do: move from an exclusive world of a few experts to an expansive existence where all can reap its benefits to improve lives. "I think that really the [GIS] revolution has been able to put the basic level of technology in many more people's hands so they can understand how they could utilize it," he said "Once they start using that, they realize the types of services they actually need."